Delayed Biological Effects

Professional Personnel

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Our knowledge of radiation effects is derived primarily from groups of people who have received high doses of radiation from acute exposures. Radiation protection standards assume that any dose of radiation, no matter how small, involves a possible risk to human health. However, available scientific evidence does not indicate any cancer risk or immediate effects at doses below 10 rem a year. At low levels of exposure, or chronic (long-term) exposures, the body's natural repair mechanisms seem to be adequate to repair radiation damage to cells soon after it occurs. The risks associated with doses less than 20 rem are not obvious because of the large underlying incidence of cancer caused by other factors.

Ionizing radiation can induce either benign or malignant tumors, which are generally described as stochastic effects. These are effects without an assumed threshold and for which increasing the absorbed dose to the individual increases the probability of a cancer, but has little or no effect on its severity. Contrary to public perception, ionizing radiation is a relatively weak carcinogen. Epidemiological studies continue on the survivors of the atomic bombing of Hiroshima and Nagasaki, involving some 86,000 people receiving doses from acute exposures at levels ranging up to more than 500 rad. These have shown that radiation is the likely cause of 334 deaths from cancer, (as opposed to the several thousand expected) in addition to the normal incidence found in any population. From this data the International Council on Radiation Protection (ICRP) and others estimate the fatal cancer risk as 5% per 100 rem exposure for a population of all ages.

In 1990 the US National Cancer Institute (NCI) found no evidence of any increase in cancer mortality among people living near to 62 major nuclear facilities. The NCI study was the broadest of its kind ever conducted and supported similar studies conducted elsewhere in the US as well as in Canada and Europe.

Other latent effects of concern from exposure to ionizing radiation include genetic effects expressed in subsequent generations and other noncancer mortality. No hereditary effects have been seen in human studies below the absorbed dose of 50 rem to the gonads. Above that dose is not sufficient human data to allow risk estimation. As a result, risk estimates to humans have been based largely on the analyses of animal data. The National Council on Radiation Protection and Measures (NCRP) has developed a risk coefficient for severe genetic effects of $1X10^{-2}$ per 10 rem for populations of all ages exposed to low absorbed dose and absorbed-dose rates.

The other causes of noncancer mortality include diseases of the circulatory, digestive and respiratory systems. Again statistical increases in mortality were attributed to diseases observed in atomic-bomb survivors. There is insufficient data to determine a dose-response relationship, however current data appears to show risks disappear below 10 rem. The relative increase in mortality rate of these diseases for individuals receiving doses to 100 rem is approximately 10 percent.

Sources

Uranium Information Center, http://www.uic.com.au/
NCRP Report No. 138

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